

# IBM SmartCloud Desktop Infrastructure: VMware View on IBM Flex System

## IBM Redbooks Solution Guide

The IBM® SmartCloud™ Desktop Infrastructure offers robust, cost-effective, and manageable virtual desktop solutions for a wide range of clients, user types, and industry segments. These solutions can help to increase business flexibility and staff productivity, reduce IT complexity, and simplify security and compliance. Based on a reference architecture approach, this infrastructure supports various hardware, software, and hypervisor platforms. Figure 1 illustrates the SmartCloud Desktop Infrastructure offering.



Figure 1. The IBM SmartCloud Desktop Infrastructure offering

The SmartCloud Desktop Infrastructure solution with VMware View running on IBM Flex System™ simplifies IT manageability and control. It delivers high fidelity user experiences across devices and networks. The features of VMware View that are included in the SmartCloud Desktop Infrastructure solution provide enhanced security, high availability, centralized management and control, and scalability.

### Did you know?

The hosted virtual desktop (HVD) approach is the most common form of implementing a virtualized user desktop environment. With HVDs, all applications and data that the user interacts with are stored centrally and securely in the data center. These applications never leave the data center boundaries. This setup makes management and administration much easier and gives users access to data and applications from anywhere and at anytime.

## Business value

Several key factors drive virtual desktops in today's business climate:

- Data security and compliance concerns
- Complexity and costs of managing existing desktop environments
- An increasingly mobile workforce
- The changing ownership of end-point devices with bring-your-own-device (BYOD) programs
- The need for rapid recovery from theft, failure, and disasters

IBM SmartCloud Desktop Infrastructure offers the following advantages:

- Simplifies desktop administration, support, and management
- Enhances security and compliance management
- Improves availability and reliability
- Enables users to work anytime, anywhere quickly and easily regardless of location or device
- Better supports growth initiatives for mobility and flexible work locations

## Solution overview

The IBM SmartCloud Desktop Infrastructure solution with VMware View on IBM Flex System includes the following components:

- User access devices
  - Desktop PCs
  - Thin clients
  - Notebooks
  - Other handheld mobile devices
- Virtual infrastructure software
  - VMware View
- Hardware platform
  - IBM Flex System
  - IBM System Storage®
- Integration services
  - Assess and plan
  - Design
  - Implement
  - Operate and manage

Figure 2 shows the functional components of the SmartCloud Desktop Infrastructure solution.

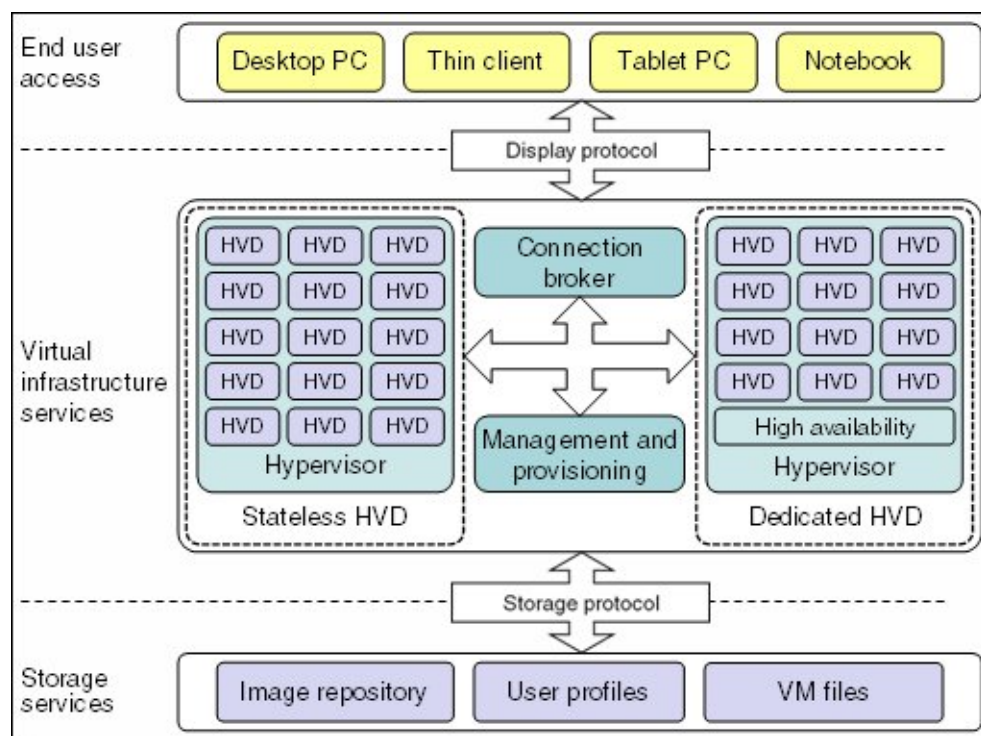


Figure 2. Functional components of the SmartCloud Desktop Infrastructure solution

The SmartCloud Desktop Infrastructure solution consists of three functional layers:

- **User access layer**  
The user access layer is a user entry point into the virtual infrastructure. This layer includes traditional desktop PCs, thin clients, notebooks, and other handheld mobile devices.
- **Virtual infrastructure services layer**  
The virtual infrastructure services layer provides the secure, compliant, and highly available desktop environment to the user. The user access layer interacts with the virtual infrastructure layer through display protocols. The RDP and PCoIP display protocols are available in VMware View solution.
- **Storage services layer**  
The storage services layer stores a user persona, profiles, gold master images, and actual virtual desktop images. The storage protocol is an interface between virtual infrastructure services and storage services. The storage protocols include Network File System (NFS), Common Internet File System (CIFS), iSCSI, and Fibre Channel.

The virtual infrastructure services layer has the following key functional components:

- **Hypervisor**  
The hypervisor provides a virtualized environment for running virtual machines (VMs) with the desktop operating systems in them. These VMs are called *hosted virtual desktops*.
- **Hosted virtual desktops**  
A HVD is a VM that runs a user desktop operating system and applications.

- Connection broker

The connection broker is the point of contact for client access devices that request the virtual desktops. The connection broker manages the authentication function and ensures that only valid users are allowed access to the infrastructure. After authentication, connection broker directs the clients to their assigned desktops. If the virtual desktop is unavailable, the connection broker works with the management and provisioning services to have the VM ready and available.

- Management and provisioning services

The management and provisioning services allow the centralized management of the virtual infrastructure, providing a single console to manage multiple tasks. These services provide image management, lifecycle management, and monitoring for hosted VMs.

- High availability services

High availability (HA) services ensure that the VM is up and running even if a critical software or hardware failure occurs. HA can be a part of connection broker functionality for *stateless HVDs* or a separate failover service for *dedicated HVDs*.

A *dedicated* (or persistent) *HVD* is assigned permanently to the specific user (similar to a traditional desktop PC). Users log in to the same virtual desktop image every time they connect. All changes that they make and each application that they install are saved when the user logs off. The dedicated desktop model is best for users who need the ability to install more applications, store data locally, and retain the ability to work offline.

A *stateless* (*pooled* or *non-persistent*) *HVD* is allocated temporarily to the user. After the user logs off, changes to the image are discarded (reset). Then, the desktop becomes available for the next user or a new desktop is created for the next user session. A persistent user experience (the ability to personalize the desktop and save data) is achieved through user profile management, folder redirection, and similar approaches. Specific individual applications can be provided to nonpersistent desktops by using application virtualization technologies, if required.

Functional layers and components are supported by a hardware infrastructure platform that must provide the following features:

- Sufficient computing power to support demanding workloads
- Scalability to satisfy future growth requirements
- Reliability to support business continuity and 24x7 operations
- High-speed low-latency networking for better user experience
- Cost-efficient storage to handle large amounts of VM and user data
- Centralized management of combined physical and virtual infrastructure from a single user interface to simplify and automate deployment, maintenance, and support tasks

IBM Flex System is a future-proof, integrated platform that satisfies these requirements.

## IBM Flex System platform

IBM Flex System is an integrated platform that delivers custom-tuned, client-specific configurations for optimum flexibility. IBM Flex System combines compute nodes, networking, storage, and management into a complete data center building block that is built for future-proof, heterogeneous data centers with flexibility and open choice of architectures, hypervisors, and environments.

Figure 3 shows the IBM Flex System.



Figure 3. IBM Flex System

IBM Flex System offers the following unique capabilities that make this platform an exceptional choice for deployment of the SmartCloud Desktop Infrastructure solution:

- Compute nodes

Compute nodes provide sufficient processing capacity for the most demanding SmartCloud Desktop Infrastructure deployments. IBM Flex System x240 is a dual-socket Intel Xeon processor E5-2600 product family-based compute node. It supports the most powerful 135 W Intel Xeon processor E5-2690, up to 768 GB of memory, and up to 16 physical I/O connections to provide scalable, high-density HVD deployments.

- Networking

SmartCloud Desktop Infrastructure requires sufficient network bandwidth and efficient traffic management to host as many VMs as possible to ensure that all computing resources are not underused. IBM Flex System networking, when integrated into a chassis, can help to reduce communication latency and provide the required bandwidth with 10 Gb Ethernet LAN connectivity that has 40 Gb uplinks and 8 Gb or 16 Gb FC SAN connectivity. Virtual Fabric Adapters offer virtual network interface card (NIC) capability to allow up to 32 logical ports on a single compute node, with controllable bandwidth allocation to manage traffic prioritization. In addition, the integrated design simplifies the overall infrastructure to save costs and make scalability and management tasks easier.

- Management

IBM Flex System Manager™ is a systems management appliance that drives efficiency and cost savings in the data center. Flex System Manager provides a pre-integrated and virtualized management environment across servers, storage, and networking that is easily managed from a single interface. A single focus point for seamless multichassis management provides an instant and resource-oriented view of chassis and chassis resources for IBM System x® and IBM Power Systems™ compute nodes. You can reduce the number of interfaces, steps, and clicks it takes to manage IT resources. You can intelligently manage and deploy workloads based on resource availability and predefined policies. And you can manage events and alerts to increase system availability and reduce downtime in addition to reducing operational costs.

- **Storage**

As a virtualized storage system that provides block volumes and file volumes, IBM Storwize® V7000 Unified complements virtual desktop environments. The system offers robust enterprise-class storage capabilities, which include thin provisioning, automated tiering, internal and external virtualization, clustering, replication, multiprotocol support, and a next-generation graphical user interface (GUI). These features can be applied in virtual desktop environments in applications, for example, that optimize storage capacity and performance or that simplify desktop user profile management and backup. The Storwize V7000 Unified is flexible enough to support entry virtual desktop environments, but can also be scaled to support enterprise virtual desktop environments.

The N series systems provide powerful virtualization and thin provisioning capabilities to help you maximize storage utilization and minimize the use of power, cooling, and floor space. At the same time, you can improve staff productivity with an integrated suite of application-aware manageability software that offers policy-based automation to otherwise manual tasks, improving storage efficiency.

In summary, because of its integrated capabilities, IBM Flex System in a SmartCloud Desktop Infrastructure solution can help to achieve the following advantages:

- Better VM density due to large memory and I/O capacity support
- Lower communication latency due to integrated switching capabilities for a better user experience
- Simplified deployment and management of both physical and virtual infrastructures due to integrated design and IBM Flex System Manager capabilities

## **Solution architecture**

IBM SmartCloud Desktop Infrastructure with VMware View simplifies desktop and application management and increases security and control. VMware View delivers a personalized high fidelity experience for users across sessions and devices. It also enables higher availability and agility of desktop services that are unmatched by traditional PCs, while reducing the total cost of desktop ownership. Users can enjoy new levels of productivity and the freedom to access desktops from more devices and locations with IT greater policy control.

The following VMware View features provide a familiar experience for the user:

- Take advantage of multiple monitor support for RDP and PCoIP, where with PCoIP, you can adjust the display resolution and rotation separately for each monitor.
- Print from a virtual desktop (in a Microsoft Windows environment) to any local or networked printer.
- Access USB devices and other peripheral devices that are connected to the local device that displays your virtual desktop.
- Manage profiles by using View Persona Management to preserve user profiles and data between sessions and to dynamically synchronize them to a remote CIFS share at configurable intervals. View Persona Management can work with or without Windows roaming profiles.

VMware View offers several levels of security features, including the following features:

- Two-factor authentication, such as RSA SecurID or RADIUS, or smart cards
- Pre-created Active Directory accounts to provision View desktops in environments that have read-only access policies for Active Directory
- SSL tunneling to ensure that all connections are encrypted

The following VMware View features provide centralized administration and management:

- Microsoft Active Directory
- Web-based administrative console
- Use of a template, or master image, to quickly create and provision pools of desktops virtual desktops updates and patches

Scalability features depend on the VMware virtualization platform to manage both desktops and servers:

- You can integrate with VMware vCenter to achieve cost-effective densities, high levels of availability, and advanced resource allocation control for your virtual desktops.
- You can use View Composer to quickly create desktop images that share virtual disks with a master image. By using linked clones in this way, you conserve disk space and simplify the management of patches and updates to the operating system.

Figure 4 shows the components of the VMware View on IBM Flex System solution.

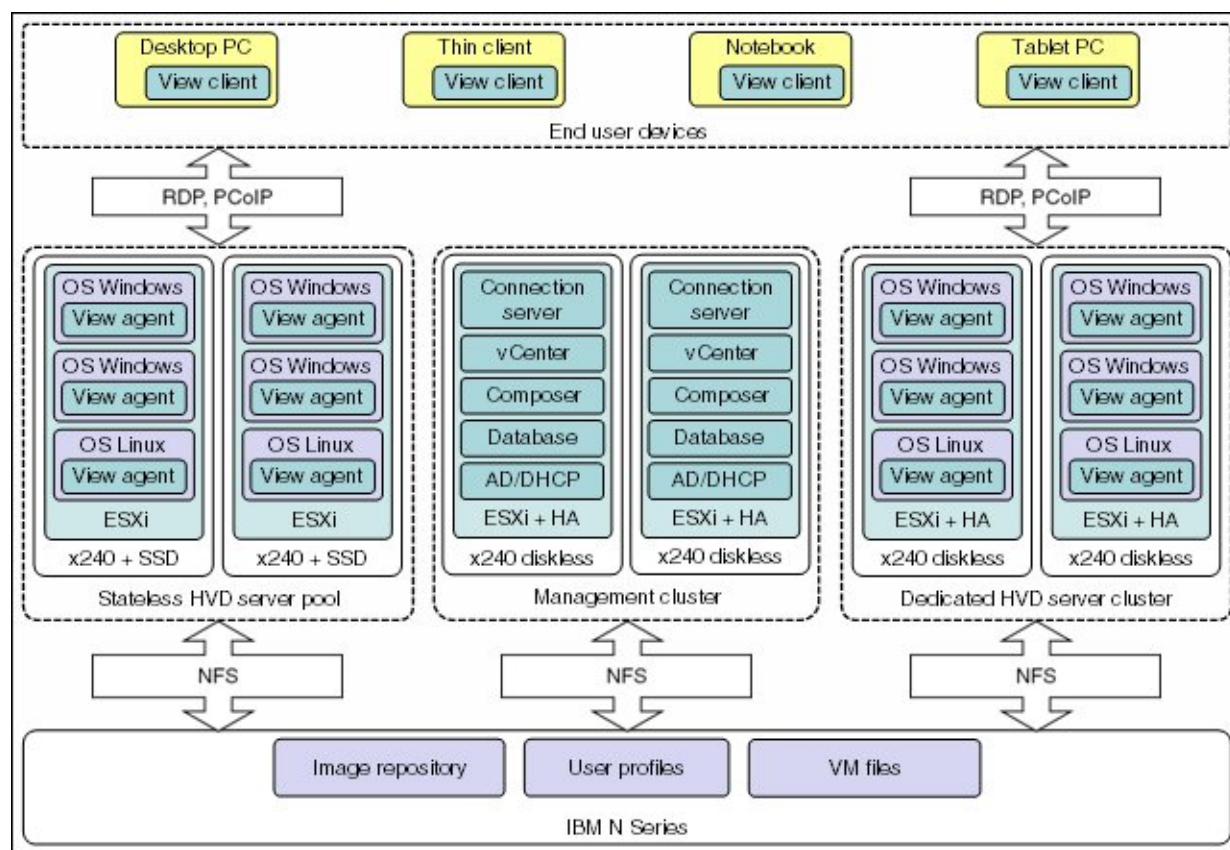


Figure 4. Components of the VMware View on IBM Flex System solution

The core hardware component of the solution is IBM Flex System with integrated x86 compute nodes, LAN switches and management appliance, and the external storage system:

- IBM Flex System x240 compute nodes

The x240 compute nodes contain embedded VMware ESXi hypervisor to host VMs that are used for virtual desktops and for management and provisioning tasks. The x240 compute nodes are combined into three groups: stateless HVD pool, dedicated HVD cluster, and management cluster.

Stateless HVD pool nodes are configured with local solid-state drive (SSD) storage that hosts VM files. The nodes use NFS storage to get local VM images from the repository. High availability is provided by the connection broker (View Connection Server). That is, if a VM or node failure occurs, the connection broker redirects the user to another available virtual desktop.

The nodes in a dedicated cluster are configured with no local storage. All VM files are placed onto an external NFS-based shared storage. High availability is provided by failing over the VM to another compute node with the VMware High Availability feature.

The nodes in management cluster host VMs are running controlling instances, such as connection broker, centralized management tools, and database for storing control information. These nodes are connected to an external NFS storage, such as IBM System Storage N series, that stores VM files. Also VMware HA provides high availability for management VMs.

- LAN switches

The IBM Flex System Fabric EN4093 10Gb Scalable Switch provides a redundant, high-speed, low-latency 10-Gb Ethernet network and NFS storage connectivity for the compute nodes.

- IBM Flex System Manager

IBM Flex System Manager is a systems management appliance that drives efficiency and cost savings in the data center. Flex System Manager provides a pre-integrated and virtualized management environment across servers, storage, and networking that is easily managed from a single interface.

- IBM System Storage N series

IBM System Storage N series storage systems provide primary and auxiliary storage for midsize enterprises, consolidating all of their fragmented application-based storage and unstructured data into one single-code system. Easily managed and expandable, this platform can help IT generalists increase their effectiveness. These systems offer integrated data access, intelligent management software, and data protection capabilities.

The VMware View core services have the following software components:

- View Client

View Client is client software to access View virtual desktops. View Client can run on a tablet; on a Windows, Linux, or Mac PC or notebook; on a thin client; and on other devices.

- View Agent

View Agent communicates with View Client to provide features such as connection monitoring, virtual printing, View Persona Management, access to locally connected USB devices, and single sign-on (SSO) capabilities.

- View Connection Server

View Connection Server is a software service that acts as a broker for client connections. View Connection Server authenticates users through Windows Active Directory and directs the request to the appropriate VM.

- VMware vCenter

VMware vCenter service acts as a central administrator for VMware ESX/ESXi servers that are connected on a network. vCenter Server provides the central point for configuring, provisioning, and managing VMs in the data center.

- View Composer

View Composer can create a pool of linked clones from a specified parent VM. Each linked clone acts similar to an independent desktop, with a unique host name and IP address, yet the linked clone requires less storage because it shares a base image with the parent.

Users can access their personalized virtual desktop from a company notebook, their home PC, a thin client device, a Mac, or a tablet. From tablets and from Mac, Linux, and Windows notebooks and PCs, users open View Client to see their View desktop. Thin client devices use View Thin Client software. They can be configured so that the only application that users can start directly on the device is View Thin Client.

## Usage scenarios

In the healthcare industry, staff are constantly on the move, but need fast, security-rich access to patients' electronic medical records that are in compliance with data privacy regulations. By combining SSO capabilities with a virtual desktop infrastructure, healthcare staff can access multiple systems and applications to obtain medical records or images with a single, more secure sign-on.

In the education industry, a virtual desktop infrastructure can help schools to extend the lifecycle of existing PCs, in addition to allowing the schools to adopt new technology. Students can receive the same quality of education, regardless of the availability of hardware, device, or location. At the same time, IT staff can reduce the time, cost, and complexity that are associated with maintenance, upgrades, provisioning, reimaging, and repairing the school's technology assets.

For the public sector, local, state, and federal agencies must extend support to an ever-increasing collection of personal devices and do so under stringent security measures. A virtual desktop can give personnel the anytime, anywhere access they need to maintain productivity. It can also provide the centralized security and control that are necessary to help maintain extreme data confidentiality. Agencies can also expedite provisioning and upgrades to multiple devices at a sustainable level of cost and effort.

## Integration

IBM SmartCloud Desktop Infrastructure enables easy integration with optional security and endpoint management technologies, including the following technologies:

- IBM Security Access Manager for Enterprise Single Sign-On offers streamlined user access with automated sign-on and sign-off plus a single password for all applications. This technology can reduce help desk costs, improve productivity, and strengthen security for virtualized desktops.
- IBM Tivoli® Endpoint Manager combines endpoint and security management into a single solution. With this solution, your team can see and manage physical and virtual endpoints, such as servers, desktops, roaming notebooks, and specialized equipment such as point-of-sale devices, automated teller machines (ATMs), and self-service kiosks.

## IBM SmartCloud Desktop Services

Transitioning to a virtualized environment from traditional desktops can be a time-consuming effort, often requiring specialized skills that are not readily available in-house. You must carefully manage implementations to support many users, applications, and complementary software to help provide the security and management functions that are necessary to succeed.

By using time-proven methods, proprietary tools, and extensive expertise that are developed through real-world client implementations, IBM SmartCloud Desktop Services can accelerate your transition to a less complex, virtualized desktop environment. Robust services, which include assessment and planning, design and implementation, and operation and management, in addition to a phased delivery approach, help to speed your return on investment and reduce the risk of business disruption. Through these services, a broader range of users, from power users to disconnected users, can have faster, more security-rich access to resources, helping to improve their productivity and increasing business flexibility.

Figure 5 illustrates the services approach.

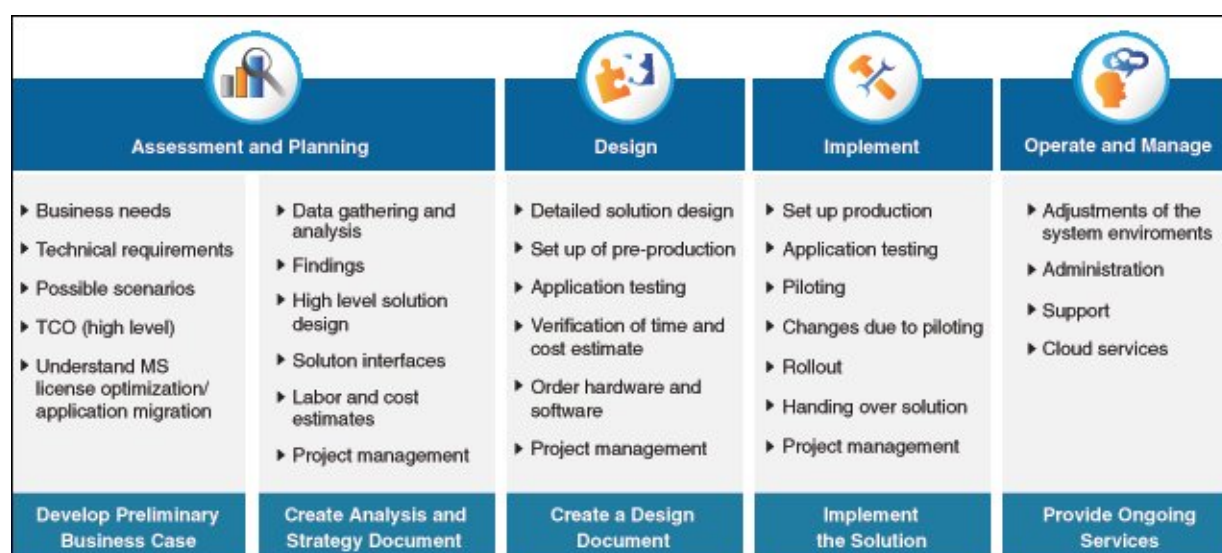


Figure 5. IBM SmartCloud Desktop Services

## Reference design

The VMware View on IBM Flex System solution has the following key building blocks:

- Compute nodes that support stateless and dedicated HVD pools
- Compute nodes cluster that runs management and provisioning tasks
- Integrated management appliance
- External shared storage system

Table 1 shows the building blocks of the VMware View on IBM Flex System solution that are used in small, medium, and large deployments, with a 50/50 split between stateless and dedicated HVDs. The actual number of users or virtual desktops per node depends on the user type and memory, CPU, and storage requirements for those VMs.

Table 1. Building blocks of the VMware View on IBM Flex System solution

Building block	Number of elements in a building block			Element type and configuration
	Small	Medium	Large	
Stateless HVD server pool (N+1 redundancy)	2	4	8	x240 compute node <ul style="list-style-type: none"><li>• 2x Intel Xeon processor E5-2680</li><li>• 256 GB memory</li><li>• 2x 200 GB SATA SSDs</li><li>• 4x 10 Gb Ethernet ports</li><li>• 1x Embedded ESXi hypervisor</li></ul>
Dedicated HVD server pool (N+1 redundancy)	2	4	8	x240 compute node <ul style="list-style-type: none"><li>• 2x Intel Xeon processor E5-2680</li><li>• 256 GB memory</li><li>• 4x 10 Gb Ethernet ports</li><li>• 1x Embedded ESXi hypervisor</li></ul>
Management cluster (N+N redundancy)	2	2	2	x240 compute node <ul style="list-style-type: none"><li>• 2x Intel Xeon processor E5-2680</li><li>• 128 GB memory</li><li>• 4x 10 Gb Ethernet ports</li><li>• 1x Embedded ESXi hypervisor</li></ul>
Management appliance	1	1	1	IBM Flex System Manager
External shared storage	1	1	1	IBM System Storage N series

Figure 6 shows the components of IBM Flex System that are used in a typical medium-sized reference design of the IBM SmartCloud Desktop Infrastructure solution, with a 50/50 split between stateless and dedicated HVDs.

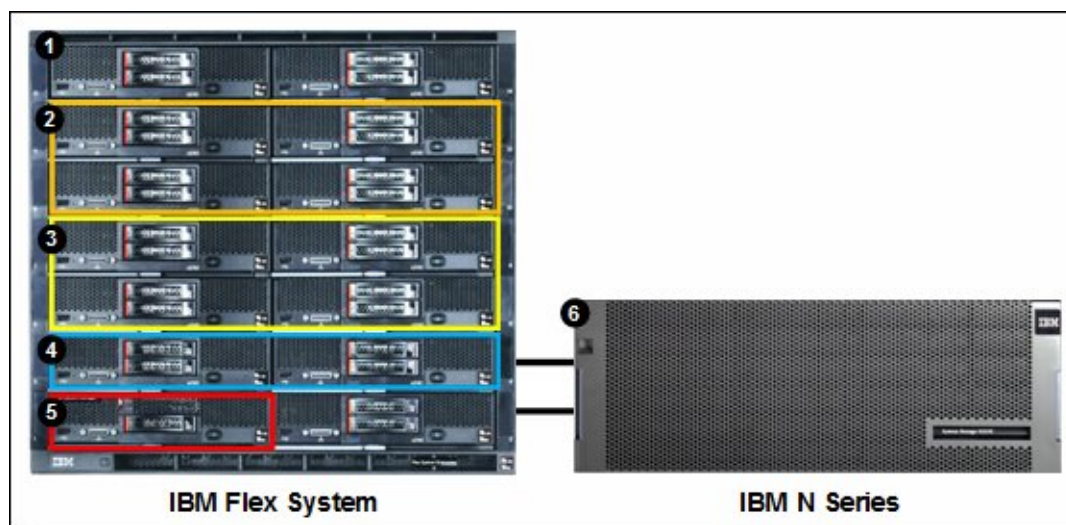


Figure 6. SmartCloud Desktop Infrastructure solution reference configuration with IBM Flex System

Table 2 highlights the details of the reference configuration of the SmartCloud Desktop Infrastructure with IBM Flex System solution that is shown in Figure 6.

Table 2. Reference configuration of SmartCloud Desktop Infrastructure with IBM Flex System (Part 1)

Diagram reference	Description
1	<b>1x Enterprise Chassis with installed infrastructure components</b> 2x EN4093 10Gb Scalable switches with activated Upgrade 1 (28 internal ports, 12 external ports) and optical SW SFP+ transceivers (not shown in Figure 6) 2x Chassis Management Modules (not shown in Figure 6)
2	<b>4x x240 compute nodes for stateless HVDs (N+1 redundancy)</b> 2x Intel Xeon processor E5-2680 256 GB memory 2x 200 GB SATA SSDs 4x 10 Gb Ethernet ports on CN4054 Virtual Fabric Adapter 1x Embedded ESXi hypervisor on a USB key
3	<b>4x x240 compute nodes for dedicated HVDs (N+1 redundancy)</b> 2x Intel Xeon processor E5-2680 256 GB memory 4x 10 Gb Ethernet ports on CN4054 Virtual Fabric Adapter 1x Embedded ESXi hypervisor on a USB key

Table 2. Reference configuration of SmartCloud Desktop Infrastructure with IBM Flex System (Part 2)

Diagram reference	Description
<b>4</b>	<b>2x x240 compute nodes for management cluster</b> 2x Intel Xeon processor E5-2680 128 GB memory 4x 10 Gb Ethernet ports on CN4054 Virtual Fabric Adapter 1x Embedded ESXi hypervisor on a USB key
<b>5</b>	<b>1x IBM Flex System Manager management appliance</b>
<b>6</b>	<b>1x IBM System Storage N series external shared storage</b>

## Ordering information

Table 3 shows the part numbers and quantities for ordering the reference configuration in Figure 6.

Table 3. Ordering information for SmartCloud Desktop Infrastructure with IBM Flex System (Part 1)

Diagram reference	Description	Part number	Qty
<b>1</b>	<b>Chassis with installed infrastructure components</b>		
	IBM Flex System Enterprise Chassis with 2x2500W PSU, Rackable	8721A1x*	1
	IBM Flex System Enterprise Chassis 2500W Power Module	43W9049	4
	IBM Flex System Enterprise Chassis 80mm Fan Module Pair	43W9078	2
	IBM Flex System Chassis Management Module	68Y7030	1
	IBM Flex System Fabric EN4093 10Gb Scalable Switch	49Y4270	2
	IBM Flex System Fabric EN4093 10Gb Scalable Switch (Upgrade 1)	49Y4798	2
	IBM SFP+ SR Transceiver	46C3447	4
<b>2</b>	<b>Compute nodes for stateless HVDs (N+1 redundancy)</b>		
	IBM Flex System x240 Compute Node (Intel Xeon processor E5-2680)	8737M1x*	4
	Intel Xeon 8C Processor Model E5-2680 130W 2.7GHz/1600MHz/20MB	81Y5188	4
	16GB (1x16GB, 2Rx4, 1.5V) PC3-12800 CL11 ECC DDR3 1600MHz LP RDIMM	00D4968	64
	IBM 200GB SATA 2.5in MLC HS SSD	43W7718	8
	IBM Flex System x240 USB Enablement Kit	49Y8119	4
	IBM Flex System CN4054 10Gb Virtual Fabric Adapter	90Y3554	4
	IBM USB Memory Key for VMware ESXi 5.0 Update 1	41Y8307	4

Table 3. Ordering information for SmartCloud Desktop Infrastructure with IBM Flex System (Part 2)

Diagram reference	Description	Part number	Qty
3	<b>Compute nodes for dedicated HVDs (N+1 redundancy)</b>		
	IBM Flex System x240 Compute Node (Intel Xeon processor E5-2680)	8737M1x*	4
	Intel Xeon 8C Processor Model E5-2680 130W 2.7GHz/1600MHz/20MB	81Y5188	4
	16GB (1x16GB, 2Rx4, 1.5V) PC3-12800 CL11 ECC DDR3 1600MHz LP RDIMM	00D4968	64
	IBM Flex System x240 USB Enablement Kit	49Y8119	4
	IBM Flex System CN4054 10Gb Virtual Fabric Adapter	90Y3554	4
	IBM USB Memory Key for VMware ESXi 5.0 Update 1	41Y8307	4
4	<b>Compute nodes for management cluster</b>		
	IBM Flex System x240 Compute Node (Intel Xeon processor E5-2680)	8737M1x*	2
	Intel Xeon 8C Processor Model E5-2680 130W 2.7GHz/1600MHz/20MB	81Y5188	2
	16GB (1x16GB, 2Rx4, 1.5V) PC3-12800 CL11 ECC DDR3 1600MHz LP RDIMM	00D4968	16
	IBM Flex System x240 USB Enablement Kit	49Y8119	2
	IBM Flex System CN4054 10Gb Virtual Fabric Adapter	90Y3554	2
	IBM USB Memory Key for VMware ESXi 5.0 Update 1	41Y8307	2
5	<b>Management appliance</b>		
	IBM Flex System Manager Node with embedded 10Gb Virtual Fabric, Xeon 8C E5-2650 95W 2.0GHz/1600MHz/20MB, 8x4GB, 1TB HS 2.5in SATA, 2x200GB 1.8in SATA SSD	8731A1x*	1
	IBM Flex System Manager Per Managed Chassis with 3 Year SW S&S	90Y4222**	1
6	<b>External shared storage</b>		
	IBM System Storage N series	Varies	1

\*The x in the part number represents a country-specific letter. For example, the EMEA part number is 8731A1G, and the US part number is 8731A1U. Ask your local IBM representative for specific details.

\*\* Part number 90Y4222 is used for ordering the Features on Demand entitlement license in the United States, Canada, Asia Pacific, and Japan. Part number 95Y1174 is used for ordering the Features on Demand entitlement license in Latin America and Europe/Middle East/Africa.

## Related information

For more information, see the following documents:

- *IBM Flex System Manager Sales Manual*  
[http://www.ibm.com/common/ssi/rep\\_sm/1/897/ENUS5641-F01](http://www.ibm.com/common/ssi/rep_sm/1/897/ENUS5641-F01)
- *IBM Flex System x240 Compute Node Sales Manual*  
[http://www.ibm.com/common/ssi/rep\\_sm/1/897/ENUS8737-\\_h01](http://www.ibm.com/common/ssi/rep_sm/1/897/ENUS8737-_h01)
- *IBM Flex System Enterprise Chassis Sales Manual*  
[http://www.ibm.com/common/ssi/rep\\_sm/1/897/ENUS7893-\\_h01](http://www.ibm.com/common/ssi/rep_sm/1/897/ENUS7893-_h01)
- *IBM Flex System Enterprise Chassis Product Guide*, TIPS0863  
<http://www.redbooks.ibm.com/abstracts/tips0863.html>
- *IBM Flex System Fabric EN4093 10Gb Scalable Switch Product Guide*, TIPS0864  
<http://www.redbooks.ibm.com/abstracts/tips0864.html>
- *IBM Flex System x240 Compute Node Product Guide*, TIPS0860  
<http://www.redbooks.ibm.com/abstracts/tips0860.html>
- *IBM Flex System Manager Product Guide*, TIPS0862  
<http://www.redbooks.ibm.com/abstracts/tips0862.html>
- *IBM Flex System CN4054 10Gb Virtual Fabric Adapter Product Guide*, TIPS0868  
<http://www.redbooks.ibm.com/abstracts/tips0868.html>
- *IBM Flex System Products and Technology*, SG24-7984  
<http://www.redbooks.ibm.com/abstracts/sg247984.html>
- *Implementing Systems Management of IBM PureFlex System*, SG24-8060  
<http://www.redbooks.ibm.com/abstracts/sg248060.html>
- xREF - IBM System x Reference Sheets  
<http://www.redbooks.ibm.com/xref>
- IBM Redbooks Product Guides for IBM Flex System servers and options  
<http://www.redbooks.ibm.com/portals/puresystems>
- IBM Flex System Information Center  
<http://publib.boulder.ibm.com/infocenter/flexsys/information/index.jsp>
- *IBM System x Configuration and Options Guide*  
<http://www.ibm.com/systems/xbc/cog>
- IBM System x Support Portal  
<http://ibm.com/support/entry/portal>

# Notices

This information was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service. IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

*IBM Director of Licensing, IBM Corporation, North Castle Drive, Armonk, NY 10504-1785 U.S.A.*

**The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law:** INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you. This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product and use of those Web sites is at your own risk. IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you. Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products. This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurement may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

## COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrate programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs.

**© Copyright International Business Machines Corporation 2012. All rights reserved.**

Note to U.S. Government Users Restricted Rights -- Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

This document was created or updated on October 30, 2012.

Send us your comments in one of the following ways:

- Use the online **Contact us** review form found at:  
[ibm.com/redbooks](http://ibm.com/redbooks)
- Send your comments in an e-mail to:  
[redbook@us.ibm.com](mailto:redbook@us.ibm.com)
- Mail your comments to:  
IBM Corporation, International Technical Support Organization  
Dept. HYTD Mail Station P099  
2455 South Road  
Poughkeepsie, NY 12601-5400 U.S.A.

This document is available online at <http://www.ibm.com/redbooks/abstracts/tips0920.html> .

## Trademarks

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both. These and other IBM trademarked terms are marked on their first occurrence in this information with the appropriate symbol (® or ™), indicating US registered or common law trademarks owned by IBM at the time this information was published. Such trademarks may also be registered or common law trademarks in other countries. A current list of IBM trademarks is available on the Web at <http://www.ibm.com/legal/copytrade.shtml>

The following terms are trademarks of the International Business Machines Corporation in the United States, other countries, or both:

IBM Flex System™	Power Systems™	Storwize®
IBM Flex System Manager™	PureFlex™	System Storage®
IBM SmartCloud™	Redbooks®	System x®
IBM®	Redbooks (logo)®	Tivoli®

The following terms are trademarks of other companies:

Intel Xeon, Intel, Intel logo, Intel Inside logo, and Intel Centrino logo are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

Linux is a trademark of Linus Torvalds in the United States, other countries, or both.

Microsoft, Windows, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

Other company, product, or service names may be trademarks or service marks of others.